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KNOWLEDGE AND ADOPTION OF ORCHARD GROWERS REGARDING SUBSIDIARY CROP CULTIVATION PRACTICES

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ABSTRACT

Subsidiary crop cultivation enhances resource use efficiency, income stability and sustainability in orchard-based systems. The present study assessed the knowledge and adoption levels of orchard growers regarding subsidiary crop cultivation practices in Southern Rajasthan. The study was conducted in Udaipur and Banswara districts with 240 respondents selected through a multistage sampling method. Data were collected using a structured and pre-tested interview schedule and analyzed using frequency, percentage, mean, standard deviation, Mean Percent Score (MPS) and the Z-test. Results showed that 67.08 per cent of orchard growers had a medium level of knowledge. Knowledge was highest for harvesting and post-harvest handling (80.06 MPS) and irrigation management (77.42 MPS), while weed management (73.36 MPS) and plant protection (70.18 MPS) were relatively low. Adoption analysis revealed that 61.25 per cent of orchard growers had a medium level of adoption. Irrigation management showed the highest adoption (54.78%), followed by land preparation (52.65%), sowing practices (51.90%) and harvesting and post-harvest management (50.25%). The study suggests the need for focused extension efforts in nutrient management, weed control and plant protection to improve the effectiveness of subsidiary crop cultivation in orchard systems.

Keywords: *orchard growers, subsidiary crops, knowledge, adoption, cultivation practice*

INTRODUCTION

Horticulture is one of the fastest-growing areas in farming today. It helps farmers increase their income, creates employment and improves the nutrition of families. Orchard farming provides long-term financial security, but fruit trees take many years to start giving full production. Because of this long waiting period, farmers often do not get a regular yearly income. To manage this, they grow subsidiary crops in the empty spaces of their orchards. Short-duration crops especially vegetables grow quickly and give farmers an immediate source of income. This also ensures better use of land, resources and helps increase household earnings.

The success of subsidiary crops depends on how much farmers know about scientific farming and how well they adopt these practices. This includes land preparation, choosing good varieties, applying fertilizers correctly, giving timely irrigation, controlling weeds, managing pests and diseases and proper harvesting and marketing. Studies have shown that farmers usually have good knowledge about basic cultural operations like land preparation and sowing, but their knowledge about nutrient management and plant protection is comparatively low (Bose & Longchar, 2022; Singh & Jahanara, 2024; Paswan *et al.* 2025). Because of this, many farmers cannot fully adopt important practices, which affect their production and income. (Abhishek *et al*. 2023; Vinaya and Tapan, 2023).

The conditions in Southern Rajasthan also influence farmers' knowledge and adoption levels. The region faces irregular rainfall, uneven land and limited access to extension services. (Tiwari *et al*. 2024). These factors create additional challenges for farmers when growing subsidiary crops scientifically (Jangir *et al*. 2023). Therefore, it is important to study the knowledge and adoption level of orchard growers so that suitable extension programmes and training can be designed. This will help improve the profitability and sustainability of orchard-based farming in the region.

OBJECTIVES

(1) To assess the level of knowledge of orchard growers regarding subsidiary crop cultivation practices.

(2) To determine the level of adoption of orchard growers regarding subsidiary crop cultivation practices.

METHODOLOGY

An ex-post-facto research design was employed

to assess the knowledge and adoption of orchard growers regarding subsidiary crop (horticultural vegetables) cultivation practices. The study was conducted in Southern Rajasthan, which comprises seven districts: Udaipur, Rajsamand, Banswara, Dungarpur, Chittorgarh, Pratapgarh and Bhilwara. Out of these, Udaipur and Banswara districts were purposively selected owing to the highest numbers of orchard growers. From each selected district, three tehsils were purposively identified based on the maximum number of orchard growers. From every tehsil, two villages were randomly selected, resulting in a total of twelve villages. A representative sample of 240 orchard growers (20 respondents from each village) was selected for the study.

Primary data were collected through a structured and pre-tested interview schedule developed to obtain information on the socio-economic characteristics of orchard growers and their knowledge and adoption of recommended subsidiary crop cultivation practices. Necessary modifications were made after pre-testing to ensure reliability and content validity.The collected data were analyzed using appropriate statistical tools such as frequency, percentage, mean, standard deviation, mean percent score (MPS) and Z-test. Ranking of practices, aspects and crops was carried out to identify areas of relative strength and weakness in the knowledge and adoption of orchard growers.

RESULTS AND DISCUSSION

The knowledge level of orchard growers

Table 1: Distribution of orchard growers by knowledge level regarding subsidiary crop cultivation practices

Sr. No.	Knowledge level	Udaipur District (n=120)		Banswara District (n=120)		Total (n=240)	
		f	%	f	%	f	%
1	**Low** (below 112.96)	22	18.33	14	11.67	36	15.00
2	**Medium** (112.96 to 129.52)	80	66.67	81	67.50	161	67.08
3	**High** (above 129.52)	18	15.00	25	20.83	43	17.92

f = frequency, % = per cent (Mean- 121.24, SD-8.28)

Table 1 presents the distribution of orchard growers according to their knowledge level. It is evident that the majority of respondents (67.08%) fell in the medium knowledge category, followed by 17.92 per cent in the high and 15.00 per cent in the low knowledge category. At the district level, the data indicate that most orchard growers in both Udaipur (66.67%) and Banswara (67.50%) possessed a medium level of knowledge regarding improved cultivation practices of subsidiary crops. These results align with similar observations reported by Singh *et al*. (2025) in drip irrigation studies. In contrast, 18.33 per cent of growers in Udaipur and 11.67 per cent in Banswara were categorized under the low-knowledge group. Meanwhile, 15.00 per cent of growers in Udaipur and 20.83 per cent in Banswara exhibited a high level of knowledge about subsidiary crop cultivation practices. Overall, these findings suggest that most of orchard growers possessed a moderate level of knowledge, which provides a base for further improvement through training and extension activities.

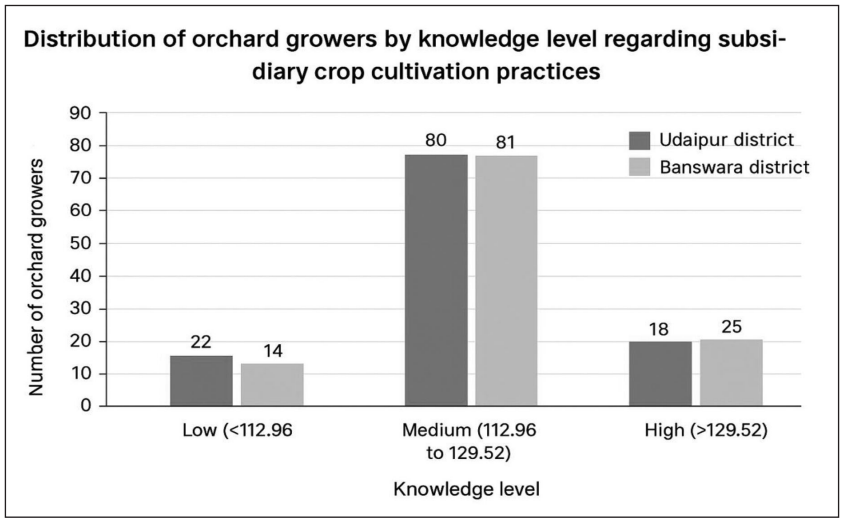

Fig. 1: Distribution of orchard growers by knowledge level regarding subsidiary crop cultivation practices

Practice-wise knowledge of orchard growers

Table 2: Practice-wise knowledge of orchard growers regarding subsidiary crops

Sr. No.	Practice	Udaipur district (n=120)		Banswara district (n=120)		Total (n=240)	
		MPS	Rank	MPS	Rank	MPS	Rank
1	**Cultural Practices**	76.77	IV	81.46	I	78.82	III
2	**Nutrient application**	77.22	III	77.19	IV	77.20	IV
3	**Irrigation management**	78.56	I	80.36	II	79.46	II
4	**Weed management**	73.87	VI	72.80	V	73.36	VI
5	**Plant protection measures**	75.92	V	67.66	VI	77.03	V
6	**Harvesting and post harvesting handlings**	78.07	II	77.28	III	80.06	I

MPS = Mean percent score

Table 2 depicts the practice-wise knowledge of orchard growers. The highest knowledge was reported in harvesting and post-harvest handling (80.06 MPS), followed by irrigation management (79.46 MPS) and cultural practices (78.82 MPS). These findings are consistent with earlier reports on practical knowledge patterns among vegetable growers (Natwadia *et al*. 2022). On the other hand, nutrient application (77.20 MPS), plant protection measures (77.03 MPS) and weed management (73.36 MPS) ranked lower, highlighting areas where growers require further training and guidance.

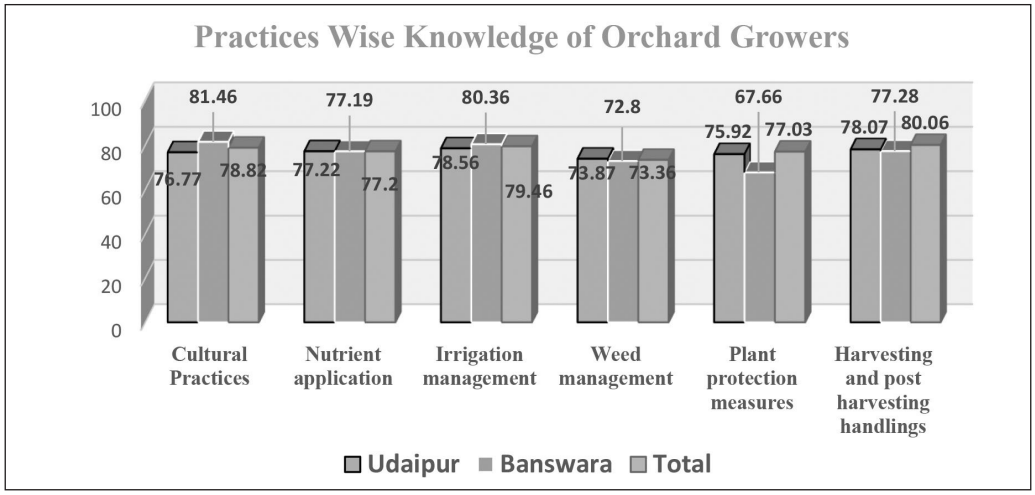

Fig. 2: Practice-wise knowledge of orchard growers regarding subsidiary crops

The aspect-wise knowledge of orchard growers regarding subsidiary crop cultivation practices was evaluated using the Mean Percent Score (MPS) and ranks were assigned to highlight areas of strength and gaps in specific practices. The results are summarized in Table 3.

Among cultural practices, soil and land preparation recorded the highest knowledge level (87.34 MPS), followed by nursery raising and management (84.22 MPS), seed rate and spacing (79.95 MPS), transplanting of seedlings (78.33 MPS), use of improved varieties (78.85 MPS), soil and seed treatment (76.20 MPS) and sowing season and method (70.42 MPS).In nutrient application, application of organic manures demonstrated the highest knowledge (90.90 MPS), followed by application of fertilizers (80.31 MPS). For irrigation management, knowledge was higher for methods of irrigation (82.66 MPS) compared to recommended irrigation schedules for different seasons (78.75 MPS).

Regarding weed management, manual weeding recorded the highest knowledge (83.80 MPS), followed by weedicide application (71.93 MPS) and mulching (59.17 MPS). In plant protection measures, major pest observation and chemical control scored highest (65.51 MPS), followed by disease observation and control (61.11 MPS) and management of physiological disorders (51.32 MPS).For harvesting and post-harvest handling, knowledge was highest for appropriate stage/time of harvesting (86.04

MPS), followed by packaging and marketing (79.11 MPS) and sorting and grading (78.39 MPS).

Overall, orchard growers demonstrated better knowledge in nutrient application, harvesting and post-harvest handling, irrigation management, manual weeding and soil and land preparation, whereas practices such as sowing season, mulching, plant protection measures and management of physiological disorders exhibited relatively lower knowledge, indicating areas where focused extension interventions are required.

Table 3: Aspect-wise knowledge of orchard growers about subsidiary crops

Sr. No.	Aspect -wise knowledge	Udaipur district (n=120)		Banswara district (n=120)		Total (n=240)	
		MPS	Rank	MPS	Rank	MPS	Rank
A	**Cultural Practices**						
1	Soil and land preparation	85.73	I	88.96	I	87.34	I
2	Use improved varieties	74.79	V	82.92	IV	78.85	IV
3	Seed rate and Spacing	76.25	IV	83.65	III	79.95	III
4	Nursery raising and management	83.65	II	84.79	II	84.22	II
5	Soil and seed treatment	72.40	VI	80.00	V	76.20	VI
6	Sowing season and method	69.50	VII	71.33	VII	70.42	VII
7	Transplanting of seedling	78.83	III	77.83	VI	78.33	V
B	**Nutrient application**						
1	Application of organic manures	90.83	I	94.38	I	90.90	I
2	Application of fertilizer	81.15	II	79.48	II	80.31	II
C	**Irrigation management**						
1	Methods of irrigation	82.19	I	83.13	I	82.66	I
2	recommended irrigation schedule to follow in different season	77.81	II	79.69	II	78.75	II
D	**Weed management**						
1	mulching	58.75	III	59.58	III	59.17	III
2	manual weeding (hand weeding/ hoeing etc.	81.67	I	85.94	I	83.80	I
3	Weedicide	73.75	II	70.10	II	71.93	II
E	**Plant protection measures**						
1	Major pest observation and its chemical control	64.54	I	66.48	I	65.51	I
2	Major disease observation and its chemical control	62.13	II	60.09	II	61.11	II
3	Major physiological disorder and its control	50.14	III	52.50	III	51.32	III
F	**Harvesting and post harvesting handlings**						
1	Appropriate stage/time of harvesting	86.15	I	85.94	I	86.04	I
2	sorting and Grading	76.77	III	80.00	III	78.39	III
3	Packaging and Marketing	77.50	II	80.73	II	79.11	II

MPS = Mean percent score

Crop-wise knowledge of orchard growers was compared using mean scores and the Z-test. As presented in Table 4, the calculated Z-values for tomato (2.80), brinjal (3.07), coriander (3.56), cabbage (3.02), chilli (3.20) and cauliflower (3.92) were higher than the tabulated value at the 1 per cent level of significance, indicating a significant difference in knowledge between Udaipur and Banswara. In contrast, fenugreek (0.83) and okra (1.67) recorded non-significant Z-values, reflecting similar knowledge levels among growers in both districts. Hence, the null hypothesis was rejected for six crops and accepted for fenugreek and okra. These results indicate that significant crop-wise variation exists for most crops, while fenugreek and okra showed non-significant differences due to similar traditional practices in both districts. Similar crop-wise variations were also reported by Abhishek *et al*. (2023).

Table 4: Crop-wise knowledge of the orchard growers

(n=240)

Sr. No.	Subsidiary crop	Mean Score		'Z' Value
		Udaipur (n_1=120)	Banswara (n_2=120)	
1	**Tomato**	19.41	19.94	2.80**
2	**Brinjal**	16.54	17.10	3.07**
3	**Chili**	17.85	17.20	3.20**
4	**Fenugreek**	13.30	13.45	0.83^{NS}
5	**Coriander**	12.85	13.49	3.56**
6	**Cabbage**	13.80	14.51	3.02**
7	**Cauliflower**	13.40	14.33	3.92**
8	**Okra**	12.45	12.80	1.67^{NS}

**Significant at 1 per cent level of significance
NS=Non significance

The significant variation observed in most of crops may be due to differences in the extent of commercial cultivation, availability of improved production technologies and the level of extension exposure in the two districts. Fenugreek and okra showed non-significant differences possibly because these crops are commonly grown using traditional practices in both districts, resulting in comparable knowledge levels.

Adoption level of the orchard growers regarding subsidiary crop cultivation practices

The adoption of recommended subsidiary crop cultivation practices was assessed using mean scores, Mean Percent Score (MPS) and the classification based on mean ± standard deviation. On the basis of the computed adoption scores, orchard growers were categorized into low, medium and high adoption groups.

A perusal of the data presented in Table 5 indicates that most orchard growers (61.25%) belonged to the medium adoption category, followed by 20.42 per cent in the low category and 18.33 per cent in the high category. This moderate adoption level may be attributed to limited technical knowledge regarding advanced practices such as nutrient and pest management, as also discussed by Meena *et al*. (2024) in kinnow production research.

District-wise distribution shows that the majority of orchard growers in both Udaipur (60.00%) and Banswara (62.50%) exhibited a medium level of adoption of improved subsidiary crop cultivation practices. In Udaipur, 24.17 per cent of growers were placed in the low-adoption category, while in Banswara this proportion was 16.67 per cent. A high level of adoption was observed among 15.83 per cent of growers in Udaipur and 20.83 per cent in Banswara.

Overall, the findings indicate that orchard growers in both districts have adopted subsidiary crop cultivation practices at a moderate level. This may be due to limited technical knowledge of advanced practices and restricted access to extension services, which prevents growers from fully adopting the recommended technologies.

Table 5: Distribution of orchard growers by adoption level regarding subsidiary crop cultivation practices

Sr. No.	Adoption level	Udaipur district (n=120)		Banswara district (n=120)		Total (n=240)	
		f	%	f	%	f	%
1	**Low** (below 168.69)	29	24.17	20	16.67	49	20.42
2	**Medium** (168.69 to 207.29)	72	60.00	75	62.50	147	61.25
3	**High** (above 207.29)	19	15.83	25	20.83	44	18.33

f = frequency, % = per cent (Mean- 187.99, SD-19.30)

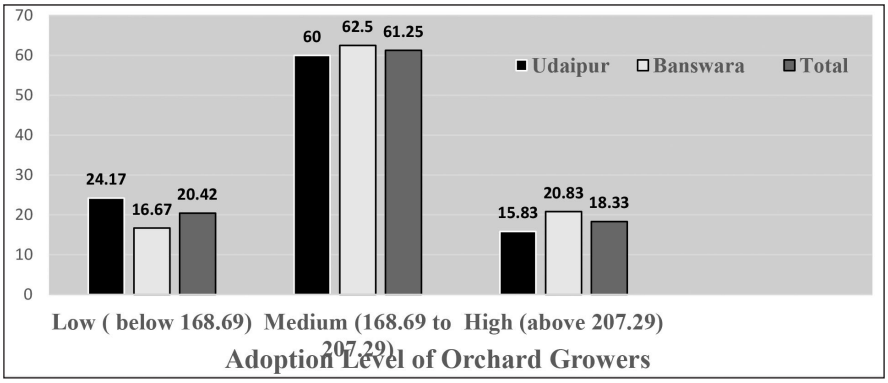

Fig. 3: Distribution of orchard growers by adoption level regarding subsidiary crop cultivation practices

Practice-wise adoption of subsidiary crop cultivation practices was assessed using Mean Percent Score (MPS) and the results are presented in Table 6. Irrigation management showed the highest level of adoption with an MPS of 68.47, securing the first rank. This aligns with earlier studies highlighting irrigation as the most widely adopted practice among horticultural growers (Singh *et al*. 2025). Harvesting and post-harvest handling ranked second with 68.24 MPS, indicating strong adoption among orchard growers. Cultural practices followed in the third position with an MPS of 61.82. Weed management was placed fourth with 54.33 MPS. Nutrient management and plant protection measures recorded relatively lower adoption, with 49.61 MPS and 49.37 MPS, ranking fifth and sixth, respectively. Overall, the findings suggest that orchard growers adopted irrigation and post-harvest practices more effectively, while additional extension support is required to improve adoption in nutrient management and plant protection.

Table 6: Practice-wise adoption of subsidiary crops by orchard growers

Sr. No.	Practice	Udaipur district (n=120)		Banswara district (n=120)		Total (n=240)	
		MPS	Rank	MPS	Rank	MPS	Rank
1	**Cultural practices**	59.26	III	64.38	III	61.82	III
2	**Nutrient management**	48.29	VI	50.94	V	49.61	V
3	**Irrigation management**	67.71	I	69.24	I	68.47	I
4	**Weed management**	55.56	IV	53.11	IV	54.33	IV
5	**Plant protection measures**	50.76	V	47.98	VI	49.37	VI
6	**Harvesting and post-harvest handlings**	67.66	II	68.82	II	68.24	II

|MPS = Mean percent score

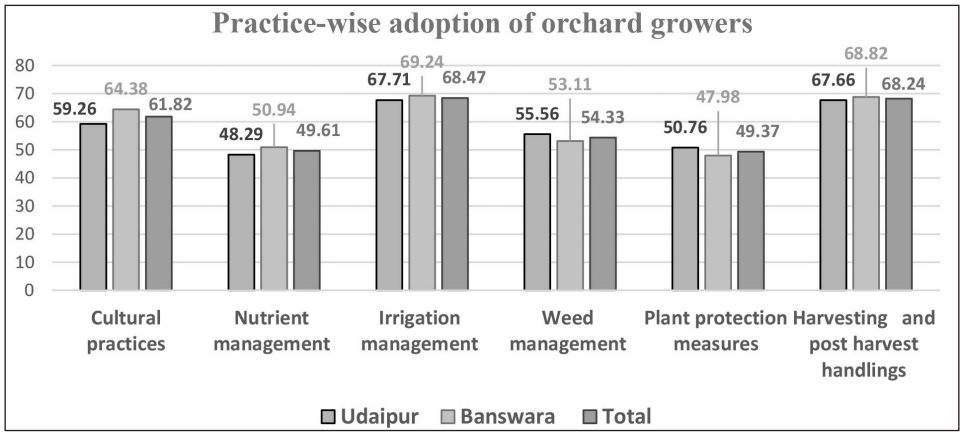

Fig. 4 : Practice-wise adoption of subsidiary crops by orchard growers

The aspect-wise adoption of subsidiary crop cultivation practices by orchard growers in Udaipur and Banswara districts was assessed using Mean Percent Score (MPS) and ranks were assigned accordingly. The results are presented in Table 7.

Table 7: Aspect -wise adoption of subsidiary crops cultivation practices by orchard growers

Sr. No.	Practice	Udaipur district (n=120)		Banswara district (n=120)		Total (n=240)	
		MPS	Rank	MPS	Rank	MPS	Rank
A	**Cultural practices**						
1	Soil and land preparation	68.75	I	76.88	I	72.81	I
2	Use improved varieties	57.34	IV	59.58	V	58.46	V
3	Seed rate and Spacing	62.24	II	69.90	II	66.07	II
4	Nursery raising and management	60.63	III	64.22	III	62.42	III
5	Soil and seed treatment	56.82	V	60.73	IV	58.78	IV
6	Sowing season and method	49.75	VII	55.42	VII	52.58	VII
7	Transplanting of seedling	52.25	VI	56.00	VI	54.13	VI
B	**Nutrient management**						
1	Application of organic manures	64.48	I	75.31	I	69.90	I
2	Application of fertilizer	59.43	II	51.56	II	56.28	II
C	**Irrigation Management**						
1	Methods of irrigation	69.53	I	73.02	I	70.21	I
2	recommended irrigation schedule to follow in different season	65.89	II	68.65	II	64.95	II
D	**Weed management**						
1	mulching	50.42	III	56.53	II	53.47	II
2	manual weeding (hand weeding/ hoeing etc.	72.81	I	72.50	I	72.66	I
3	Weedicide	55.21	II	47.76	III	51.48	III
E	**Plant protection measures**						
1	Major pest observation and its chemical control	50.42	I	47.55	I	51.61	I
2	Major disease observation and its chemical control	47.55	II	45.94	II	46.74	II
3	Major physiological disorder and its control	46.75	III	41.17	III	43.96	III
F	**Harvesting and post-harvest handlings**						
1	Appropriate stage/time of harvesting	74.06	I	76.93	I	75.49	I
2	sorting and Grading	65.05	II	63.91	III	64.48	III
3	Packaging and Marketing	63.85	III	65.63	II	64.74	II

MPS = Mean percent score

Among cultural practices, soil and land preparation recorded the highest adoption (72.81 MPS), followed by seed rate and spacing (66.07 MPS), nursery raising and management (62.42 MPS), soil and seed treatment (58.78 MPS), use of improved varieties (58.46 MPS), transplanting of seedlings (54.13 MPS) and sowing season and method (52.58 MPS). In nutrient management, the application of organic manures scored higher (69.90 MPS) than the application of fertilizers (56.28 MPS). Aspect-wise adoption revealed that soil and land preparation and the application of organic manures recorded higher adoption levels. These results agree with the findings of Chanakya and Mazhar (2025), who reported better adoption for soil-related practices in garlic chives cultivation. For irrigation management, adoption was highest for methods of irrigation (70.21 MPS), followed by recommended irrigation schedule for different seasons (64.95 MPS).

Regarding weed management, manual weeding recorded the highest adoption (72.66 MPS), followed by mulching (53.47 MPS) and use of weedicides (51.48 MPS). In plant protection measures**,** major pest observation and chemical control scored highest (51.61 MPS), followed by disease observation and control (46.74 MPS) and management of physiological disorders (43.96 MPS). For harvesting and post-harvest handling, appropriate stage/time of harvesting recorded the highest adoption (75.49 MPS),

followed by packaging and marketing (64.74 MPS) and sorting and grading (64.48 MPS).

Overall, orchard growers demonstrated better adoption in harvesting and post-harvest handling, irrigation management, manual weeding and soil and land preparation, whereas practices such as sowing season, use of fertilizers, plant protection measures and management of physiological disorders showed relatively lower adoption, highlighting areas for targeted extension interventions.

Crop-wise adoption of subsidiary crops was compared using mean scores and the Z-test. As presented in Table 8, the calculated Z-values for tomato (3.03), chilli (4.65), fenugreek (3.39), cabbage (4.14) and cauliflower (3.38) were higher than the tabulated value at the 1 per cent level of significance, indicating a significant difference in adoption between Udaipur and Banswara. In contrast, brinjal (1.25), coriander (1.17) and okra (0.49) recorded non-significant Z-values, reflecting similar adoption levels among growers in both districts. Hence, the null hypothesis was rejected for five crops and accepted for brinjal, coriander and okra.

Table 8: Crop-wise adoption of orchard growers (n=240)

Sr. No.	Subsidiary crops	Mean Score		'Z' Value
		Udaipur (n_1=120)	Banswara (n_2=120)	
1	**Tomato**	26.93	27.93	3.03**
2	**Brinjal**	24.52	24.94	1.25^{NS}
3	**Chili**	25.04	26.43	4.65**
4	**Fenugreek**	20.21	21.13	3.39**
5	**Coriander**	21.95	22.23	1.17^{NS}
6	**Cabbage**	22.63	23.81	4.14**
7	**Cauliflower**	22.98	24.07	3.38**
8	**Okra**	20.70	20.49	0.49^{NS}

**Significant at 1 per cent level of significance NS=Non significance

The significant variation observed in the adoption of most crops may be attributed to differences in market orientation, economic importance and farmers' access to crop-specific inputs and extension guidance across the two districts. Higher adoption for crops such as tomato, chilli, cabbage, cauliflower and fenugreek suggests greater commercial value and better availability of production technologies in these areas.

In contrast, the non-significant differences in the adoption of brinjal, coriander and okra indicate that these crops are largely cultivated using traditional practices in both districts, resulting in similar levels of adoption.

CONCLUSION

The study concluded that orchard growers of Udaipur and Banswara exhibited moderate levels of knowledge and adoption regarding subsidiary crop cultivation. Higher knowledge and adoption were observed in irrigation management and harvesting and post-harvesthandling, while nutrient management, weed control and plant protection recorded comparatively low levels, indicating clear technical gaps. Crop-wise analysis showed significant differences between districts for crops like tomato, chilli, cabbage, cauliflower and fenugreek, mainly due to differences in commercial cultivation and extension exposure. In contrast, no significant variation was found for brinjal, coriander and okra, reflecting similar traditional practices in both districts. Overall, the findings highlight the need to strengthen advisory support in nutrient and pest management to enhance adoption efficiency among orchard growers.

RECOMMENDATIONS

The study identified clear gaps in nutrient management, weed control and plant protection, therefore, regular training programmes, field demonstrations and advisory services should be organized to improve farmers' knowledge and skills in these areas. At the policy level, government schemes should provide better support for inputs such as organic manures, bio-fertilizers and plant protection materials to ensure affordability and easy access for farmers. District authorities should also promote facilities such as community nurseries, custom hiring centres and farmer field schools to help orchard growers adopt scientific practices more effectively.

Furthermore, crop-specific extension strategies should be developed for crops where adoption levels differ between districts, while common technology packages may be promoted for crops with similar adoption patterns.

Improving market facilities, post-harvest infrastructure and strengthening linkages with government marketing platforms will further encourage orchard growers to adopt improved subsidiary crop cultivation practices.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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